2014 ISO Flexible Capacity Needs Assessment: Study Methodology, Assumptions, and Preliminary Results

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Overview

- Data collected from LSEs
- Expected renewable build-out as of April 2014
- Load forecast and wind/solar build-out for future years
- 3-hour flexible requirements for 2015-2016
  - Maximum 3-hour ramps
  - Contingency reserve
- CPUC LSEs’ contribution to flexible capacity needs
- Flexible capacity categories

Disclaimers

- The results shown in the presentation are preliminary and should not be considered final
- The ISO is still in the process of validating the data submissions with the scheduling coordinators for the LSEs and following-up with those scheduling coordinators that did not reply to the data request
- The ISO will re-run the assessment if warranted
- The ISO will issue the final results of this study to each LRA with the Final Local Capacity Requirements study

Summary of preliminary assessment results

- Flexible Capacity need is largest in the off-peak months
  - Flexible capacity makes up a greater percentage of resource adequacy needs during the off-peak months
  - Increase almost exclusively caused by 3-hour ramp, not increase in peak load
- Lower forecasts of variable energy resource build out contributes to lower flexible capacity requirements
- Compared to last year’s forecast of 2015 flexible capacity needs:
  - Flexible capacity needs are lower in many months,
  - Distribution of daily maximum three-hour net-load ramps are comparable
- Using the ISO flexible capacity contribution calculation majority of three-hour net-load ramps are attributable to CPUC jurisdictional LSEs
- Flexible capacity categories demonstrate that there is ample opportunity for participation from various resource types

Study Methodology and Assumptions

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Senior Advisor, Renewable energy Integration

Analysis Methodology

- External resources that are firmed by another balancing authority are treated as firm imports and are not included in the flexible capacity requirements assessment
- Dynamically scheduled external resources that are not firmed are treated comparably to internal ISO resources
- The ISO assumed no additional growth of VERs for the LSEs that did not submit a response to the ISO's data request
- Changes in distributed Solar PV resources are assumed to be captured in load forecast

Summary of aggregated expected variable energy resources build-out collected from load serving entities

R.12-03-014 Replicating Base Case) Load	Existing (2013)	2014	2015	2016
ISO Solar PV	4,173	4,504	5,700	6,200
ISO Solar Thermal	419	1,058	1,183	1,183
ISO Wind	5,351	5,728	5,578	5,578
Distributed PV	1,280	1,971	2,353	2,740
Sub Total of VER	***11,223***	***13,261***	***14,814***	***15,701***
Non ISO Resources All external variable energy resources not firmed by external BAA and treated as dynamic schedule into the ISO	127	127	317	467
Non ISO Resources All external VERS firmed by external BAA	398	398	398	398
Total ISO and Non-ISO Resources used in the 2014 Flexible Capacity Needs Assessment	**11,621**	**13,659**	**15,212**	**16,099**
Incremental New Additions in Each Year		2,038	1,553	887
Final estimated build out used in the 2013 Flexible Capacity Needs Assessment (for comparison purposes)	**11,906**	**14,374**	**15,779**	**17,382**

The monthly flexibility capacity requirement is calculated using the most recent full year of the ISO's load, wind, and solar 1-minute data

- Use 2013 actual ISO's load, wind and solar 1-minute data
- For new VERs installation, use NREL's simulated production data for CREZs located in close geographic proximity to develop minute-by-minute production profiles
- Solar profiles were created using both technology type and location of the new resources
- Generate net-load profiles for 2014 through 2016
  - Generate 1-minute load profiles for 2014 through 2016
  - Generate 1-minute solar profiles for 2014 through 2016
  - Generate 1-minute wind profiles for 2014 through 2016

The ISO used the CEC's 2013 IEPR 1-in-2 monthly peak load forecast with no additional achievable energy efficiency to develop the load forecast

- Used 2013 actual 1-minute load data to build 1-minute load profiles for subsequent years
- Scaled the actual 1-minute load value of each month of 2013 to CEC forecasts for 2015 and 2016 using a load growth factor of monthly peak forecast divided by actual 2013 monthly peak

2014 Load Growth Assumptions

- Scale the actual 1-minute load value of each month of 2013 by the fraction $(\text{Monthly}_{2014\_Peak\_Load\_Forecast}/\text{Monthly}_{2013\_Actual\_Peak\_Load})$

2015 Load Growth Assumptions

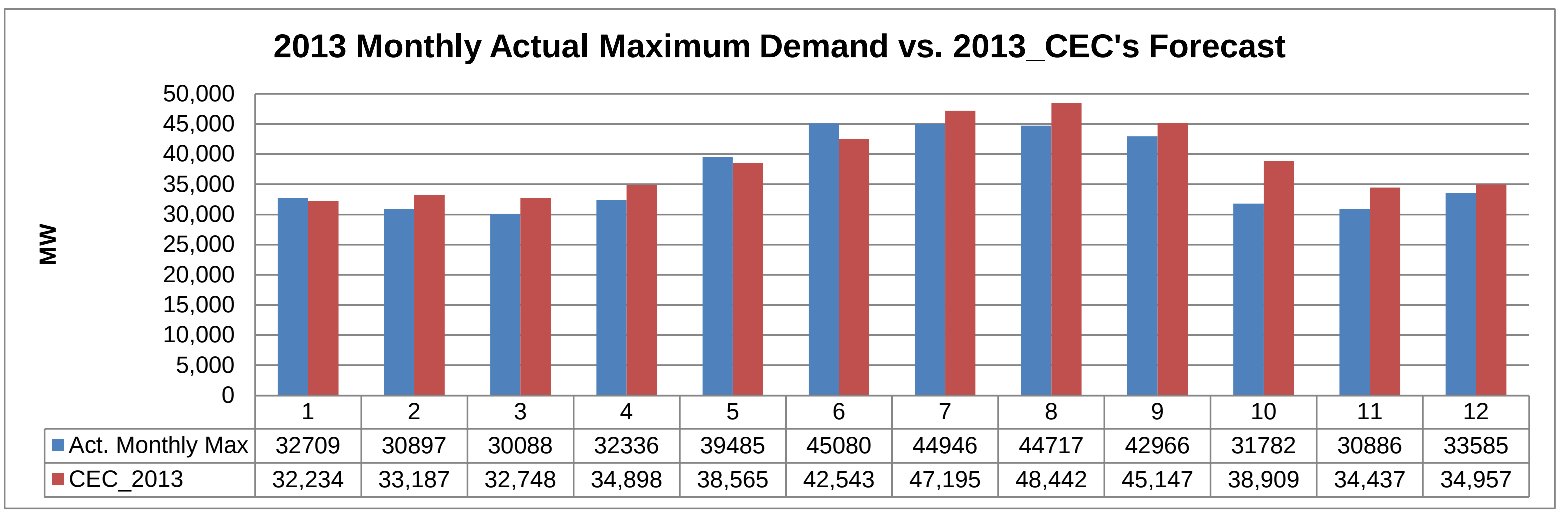
- Scale each 1-minute load data point of 2014 by the fraction $(\text{Monthly}_{2015\_Peak\_Load\_Forecast}/\text{Monthly}_{2014\_Peak\_Load})$

2016 Load Growth Assumptions

- Scale each 1-minute load data point of 2015 by the fraction $(\text{Monthly}_{2016\_Peak\_Load\_Forecast}/\text{Monthly}_{2015\_Peak\_Load})$

ISO Coincident 1 in 2 monthly peak load forecast (MW) and 2013 monthly actual peak load vs. CEC forecast

Mid Demand Scenario, No AAEE					
Month	**2013**	**2014**	**2015**	**2016**	**2017**
January	32,234	32,879	33,513	33,915	34,336
February	33,187	33,851	34,504	34,918	35,351
March	32,748	33,404	34,048	34,456	34,884
April	34,898	35,596	36,282	36,718	37,174
May	38,565	39,337	40,095	40,577	41,080
June	42,543	43,394	44,230	44,761	45,317
July	47,195	48,140	49,068	49,657	50,273
August	48,442	49,412	50,364	50,969	51,602
September	45,147	46,051	46,938	47,502	48,092
October	38,909	39,688	40,453	40,938	41,446
November	34,437	35,127	35,804	36,233	36,683
December	34,957	35,657	36,344	36,781	37,237

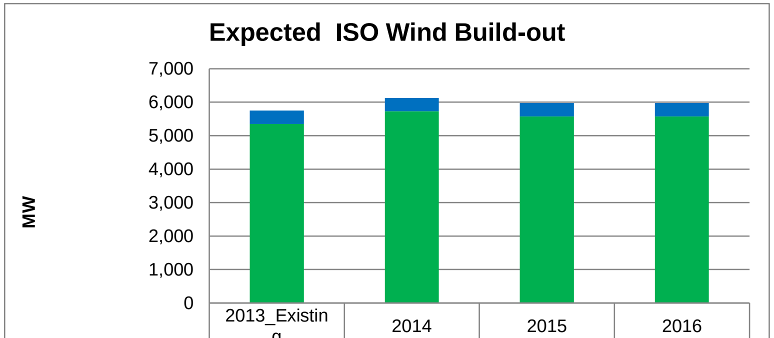


Wind growth assumptions

- Use actual 1-minute wind production data for the most recent year e.g. 2013 actual 1-minute data was used to build 2014 1-minute data
- 1-minute wind profiles for projects installed in 2013 were created using 2013 actual data for the months the projects were not in-service (i.e. profiles for projects installed in May 2013 were created for January through April)
- Wind 1-minute profiles for 2014 were created by scaling the 1-minute wind data for 2013 based on installed capacity

$2014\ W_{1\text{-}min} = 2013W_{Actual\_1\text{-}min} * 2014W_{Installed\ Capacity}/2013W_{Installed\ Capacity}$

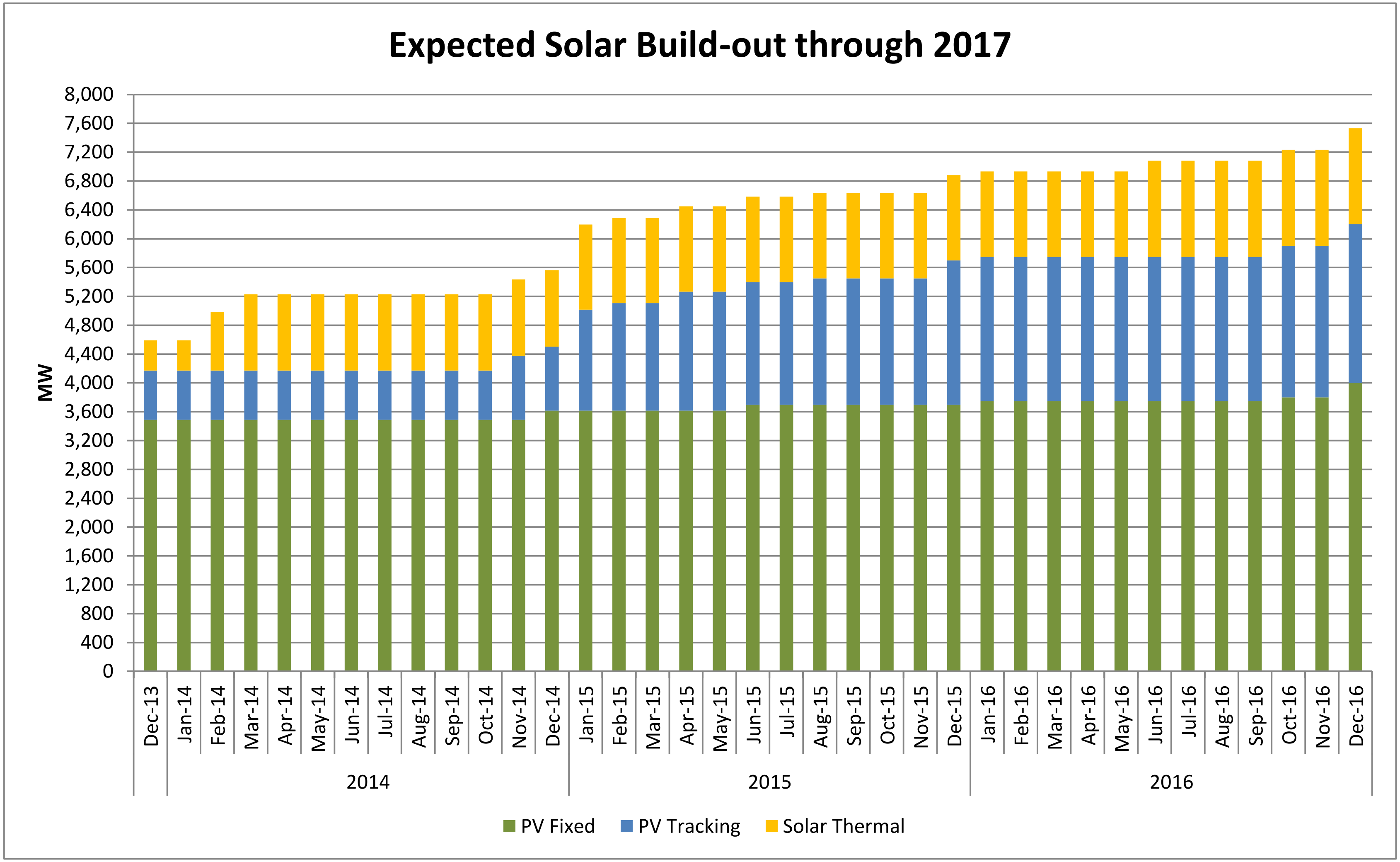
- 398 MW of wind resources were not modeled because they are expected to be firmed outside the ISO
- Maintained load/wind correlation for over 94% of the wind capacity



	2013_Existing	2014	2015	2016
Wind (Firmed_Ext)	398	398	398	398
Wind (ISO)	5351	5728	5578	5578

Wind peak production: 4,244 MW on 6/17/2013

Expected solar build-out as of 2013 using LSE's data shows a significant increase in solar PV tracking



Solar Peak Production: 4,278 on 4/7/2014

Solar growth assumptions

Existing solar

- Use actual solar 1-minute production data for the most recent year (e.g. 2013 actual 1-minute solar data was used to develop 2014 profile
- 1-minute solar profiles for projects installed in 2013 were created for the months the projects were not in-service using 2013 actual solar data

New solar installation

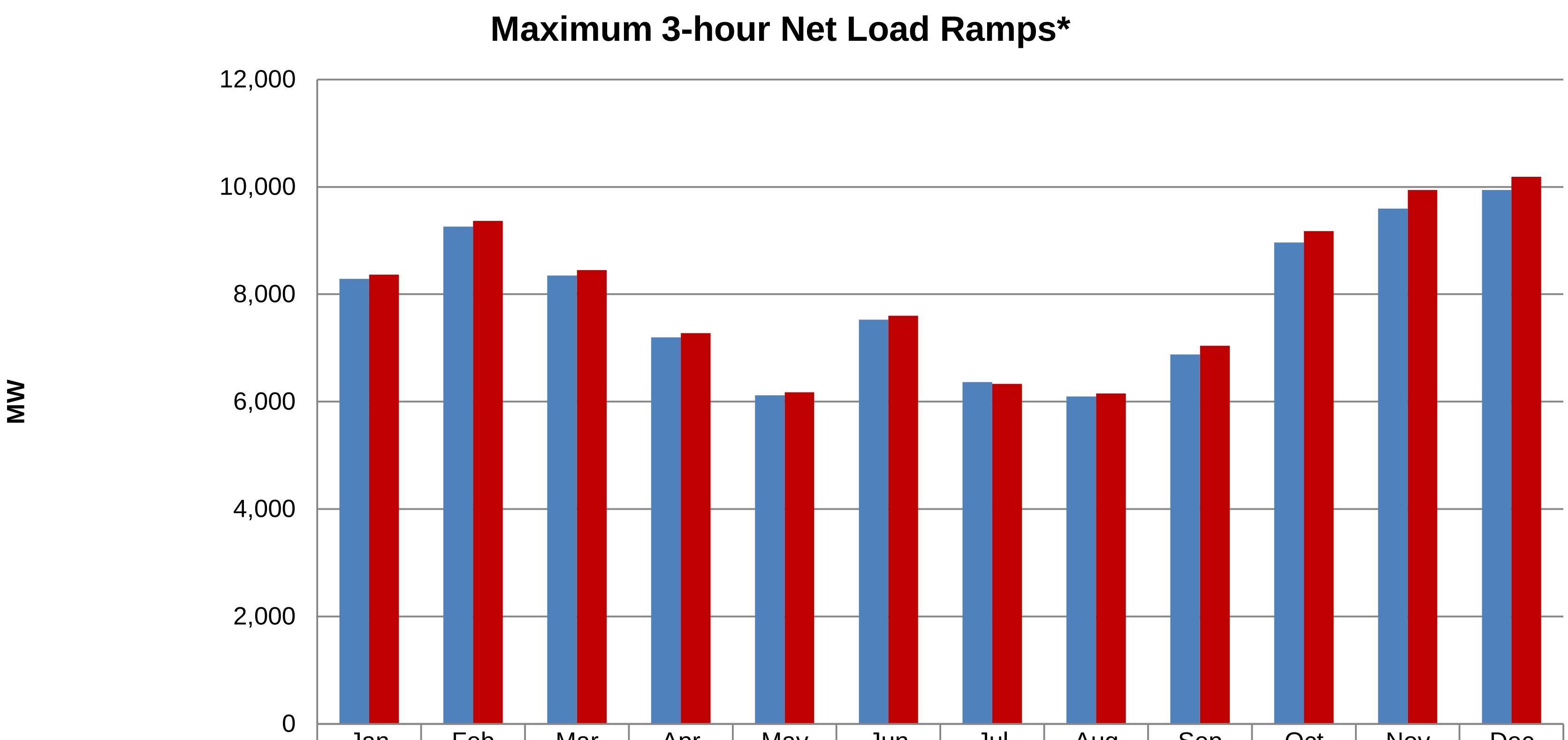
- Develop 1-minute solar production profiles for CREZs based on their geographic location and technology using NREL's 2005 solar profiles (i.e. solar thermal, solar PV tracking & solar PV fixed)
- Aggregate all new solar 1-minute production data by technology
- New CREZs does not have the load/solar correlation but the maximum 3-hour ramps during the non-summer months are highly influenced by sunset which is consistent with existing solar data
- Sum the actual 1-minute existing solar production data with the aggregated simulated solar data for new installation

$$\textbf{Total solar } 2014_{\text{1-min}} = 2013_{\text{Actual\_1-min}} + 2014_{\text{Simulated\_1-min data}}$$

Preliminary Results

Karl Meeusen, Ph.D.
Market Design and Regulatory Policy Lead

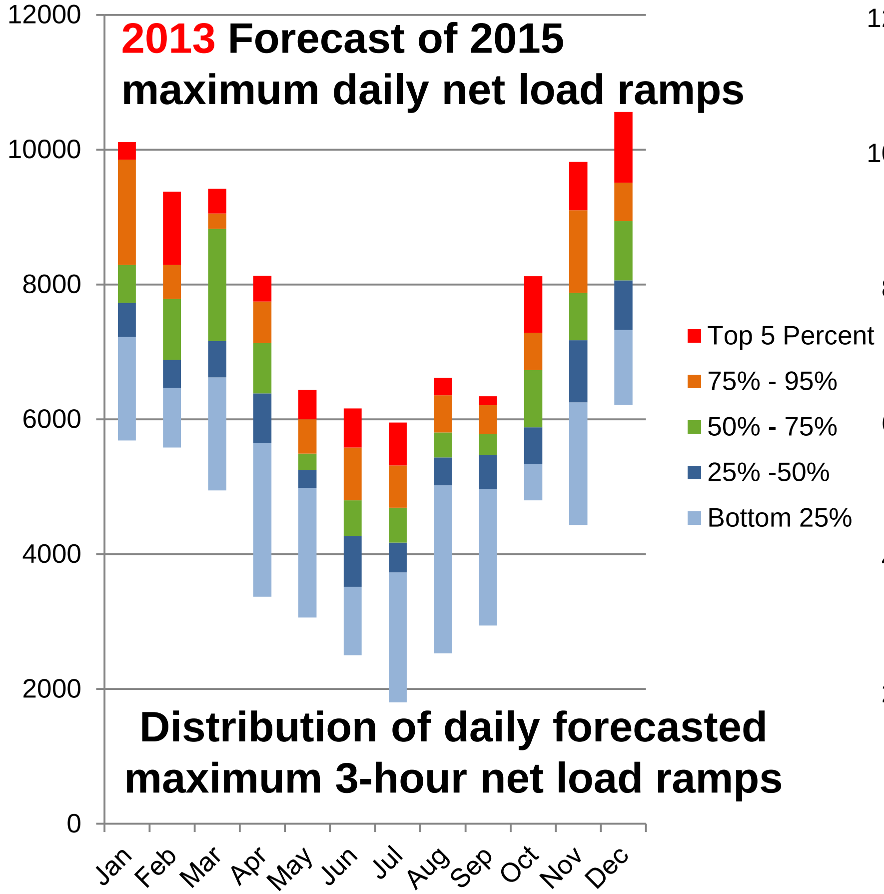
Forecasted maximum monthly three-hour net-load ramps

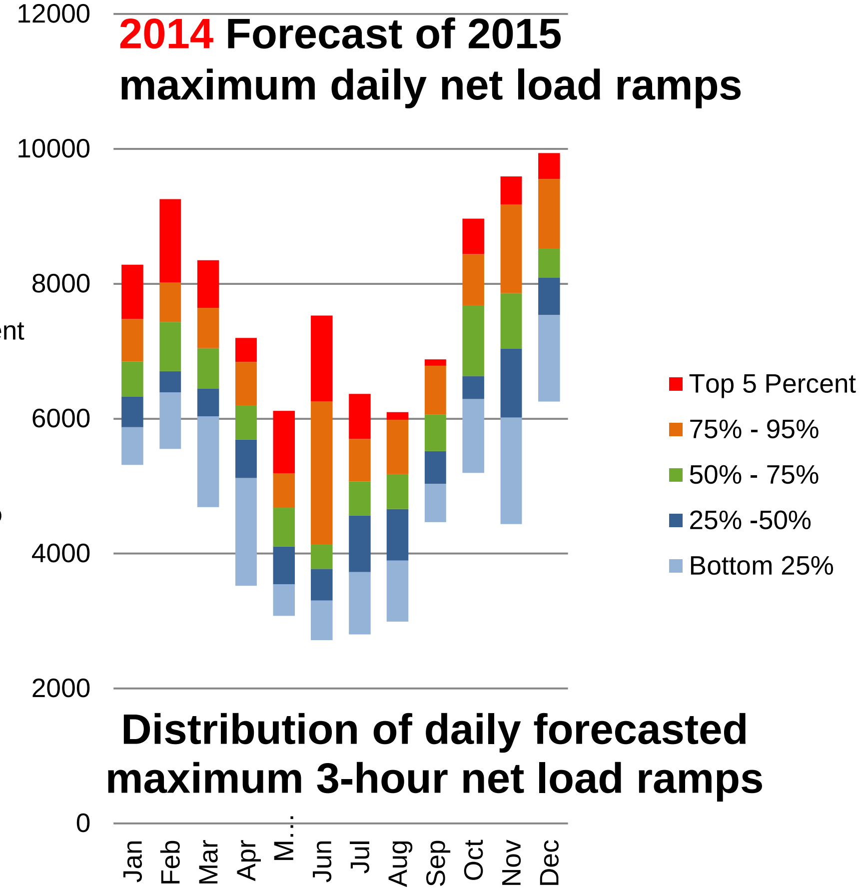


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max of 3_hr_ramp_2015	8286	9257	8351	7198	6117	7530	6366	6098	6881	8965	9595	9940
Max of 3_hr_ramp_2016	8363	9367	8450	7275	6176	7600	6334	6150	7044	9177	9940	10190

* Excludes contingency reserves

The distribution range of daily maximum 3-hour net load ramps relative to last year's assessment





The proposed interim flexible capacity methodology designed to provide the ISO with sufficient flexible capacity

- Methodology

  $\text{Flexibility Requirement}_{MTHy} = \text{Max}[(3RR_{HRx})_{MTHy}] + \text{Max}(\text{MSSC}, 3.5\%*E(PL_{MTHy})) + \varepsilon$

  Where:

  $\text{Max}[(3RR_{HRx})_{MTHy}]$ = Largest three hour contiguous ramp starting in hour x for month y

  E(PL) = Expected peak load

  MTHy = Month y

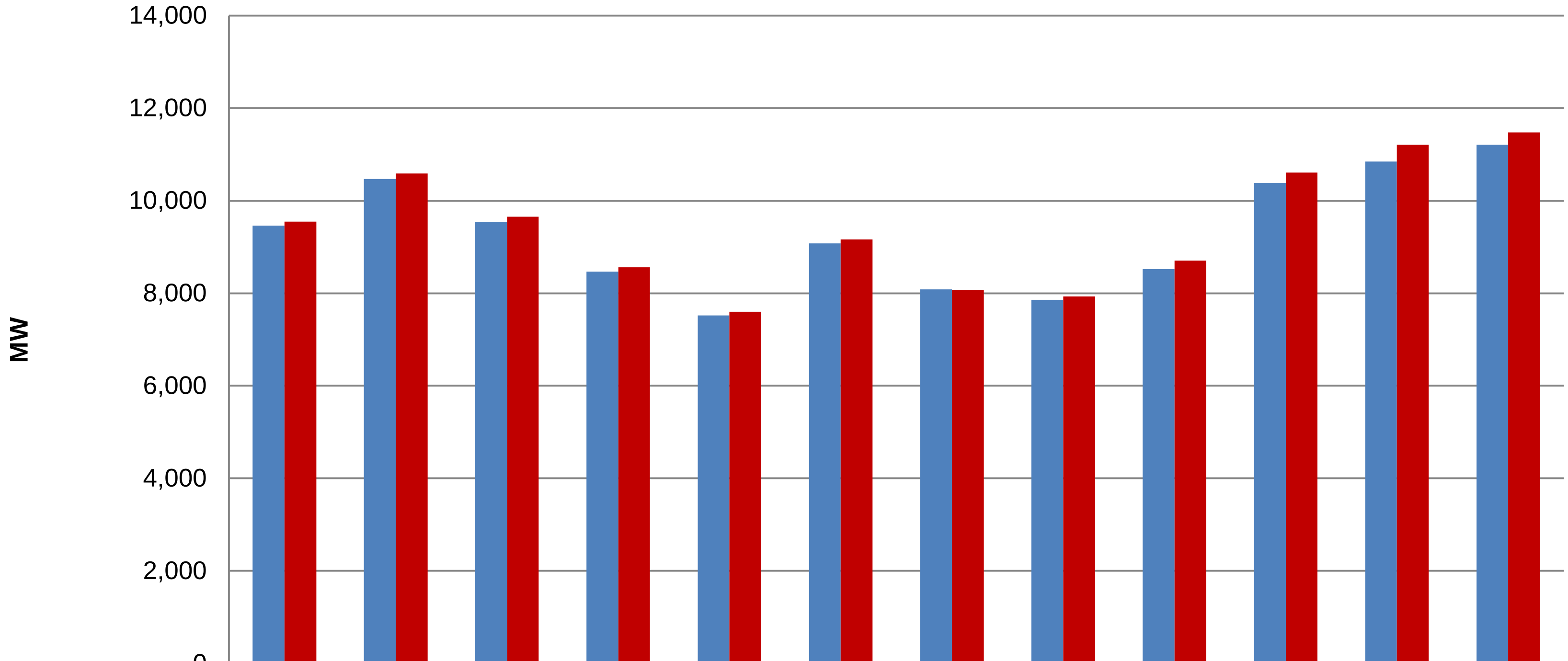
  MSSC = Most Severe Single Contingency

  ε = Annually adjustable error term to account for load forecast errors and variability

- Methodology for 2017 and beyond needs to be developed as needs change

Forecasted monthly 2015 and 2016 ISO system-wide flexible capacity needs

2015 and 2016 Monthly Flexible Requirements*



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flex_Req_2015	9,459	10,465	9,543	8,468	7,520	9,078	8,083	7,861	8,523	10,381	10,848	11,212
Flex_Req_2016	9,550	10,589	9,656	8,560	7,596	9,166	8,072	7,934	8,706	10,610	11,209	11,477

*$\text{Flexibility Requirement}_{MTHy} = \text{Max}[(3RR_{HRx})_{MTHy}] + \text{Max}(MSSC, 3.5\%*E(PL_{MTHy})) + \varepsilon$

$\varepsilon = 0$

Flexible capacity requirement is split into its two component parts to determine the allocation

- Maximum of the Most Severe Single Contingency or 3.5 percent of forecasted coincident peak
  - Allocated to LRA based on peak-load ratio share
- The largest 3-hour net-load ramp is decomposed into four components to determine the LRA's allocation

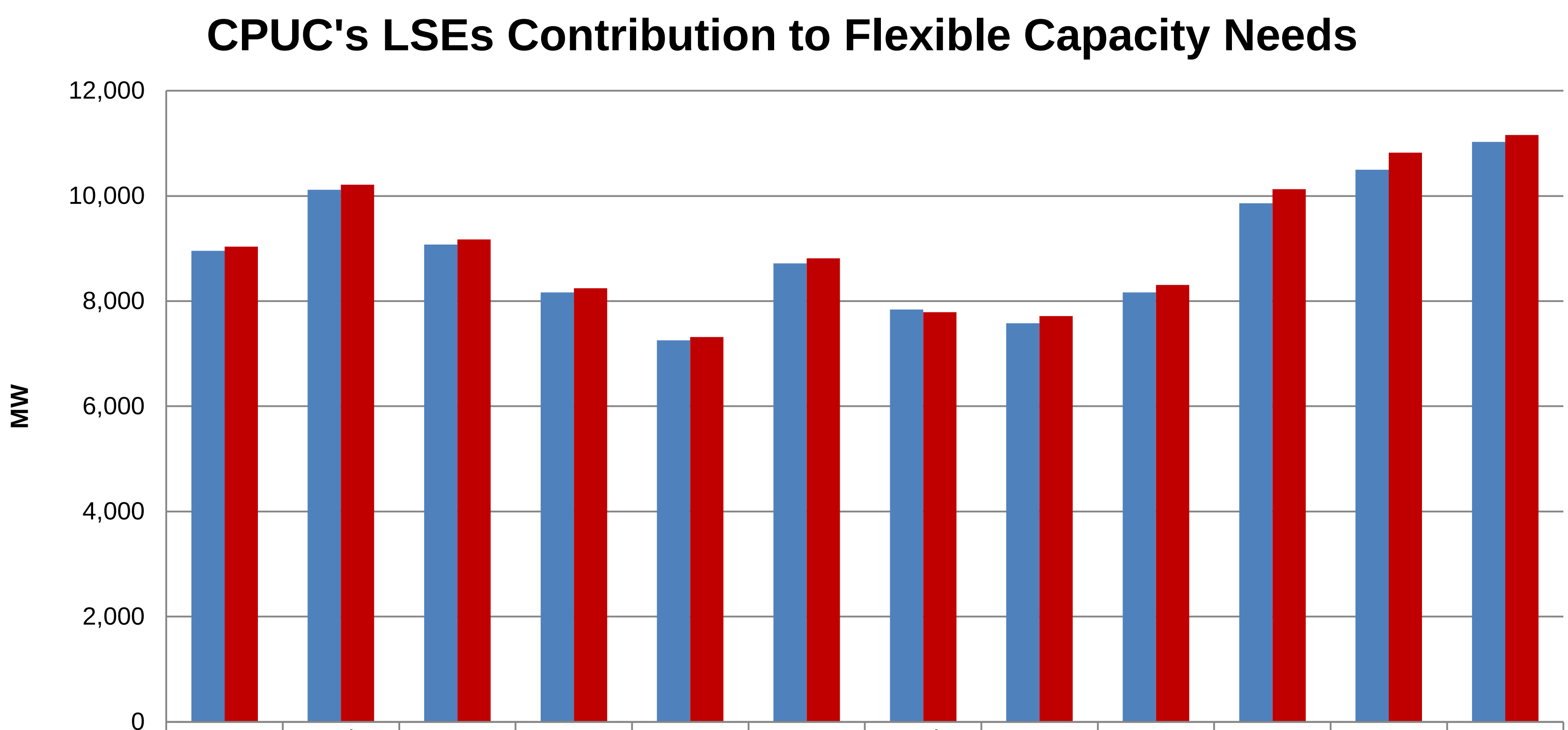
  Allocation =

  Δ Load – Δ Wind Output – Δ Solar PV – Δ Solar Thermal

Flexible capacity needs are largely attributable to CPUC jurisdictional LSE's

CPUC Jurisdictional LSEs' Contributions to Flexible Capacity Needs							
		2015			2016		
	Δ Load	Δ PV Fixed	Δ Solar Thermal	Δ Wind	Δ PV Fixed	Δ Solar Thermal	Δ Wind
Jan	94%	100%	100%	99%	99%	100%	98%
Feb	95%	100%	100%	99%	99%	100%	98%
Mar	95%	100%	100%	99%	99%	100%	98%
Apr	96%	100%	100%	99%	99%	100%	98%
May	96%	100%	100%	99%	99%	100%	98%
Jun	96%	100%	100%	99%	99%	100%	98%
Jul	98%	100%	100%	99%	99%	100%	98%
Aug	98%	100%	100%	99%	99%	100%	98%
Sep	94%	100%	100%	99%	99%	100%	98%
Oct	93%	100%	100%	99%	99%	100%	98%
Nov	96%	100%	100%	99%	99%	100%	98%
Dec	99%	100%	100%	99%	99%	100%	98%

CPUC jurisdictional LSE’s contribution to need



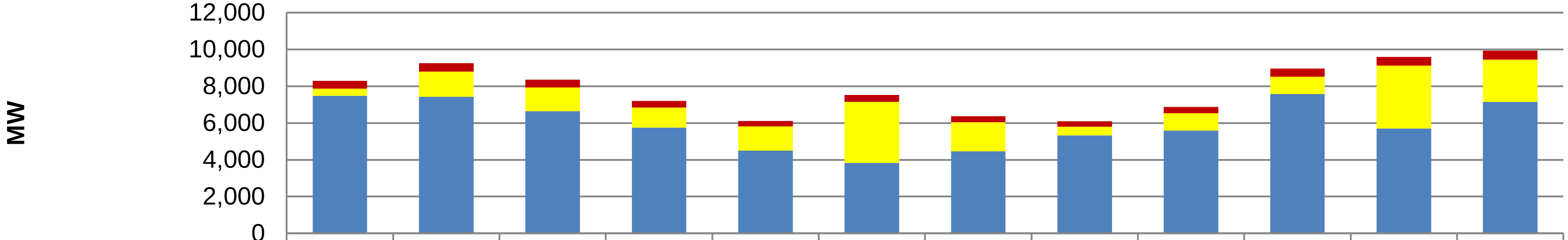
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015 Total	8,957	10,118	9,077	8,163	7,257	8,715	7,840	7,577	8,167	9,859	10,501	11,029
2016 Total	9,033	10,215	9,172	8,243	7,316	8,816	7,792	7,716	8,305	10,130	10,820	11,160

Flexible capacity categories allow a wide variety of resources to provide flexible capacity

- <u>Category 1 (Base Flexibility)</u>: Operational needs determined by the magnitude of the largest 3-hour secondary net-load ramp
- <u>Category 2 (Peak Flexibility)</u>: Operational need determined by the difference between 95 percent of the maximum 3-hour net-load ramp and the largest 3-hour secondary net-load ramp
- <u>Category 3 (Super-Peak Flexibility)</u>: Operational need determined by five percent of the maximum 3-hour net-load ramp of the month

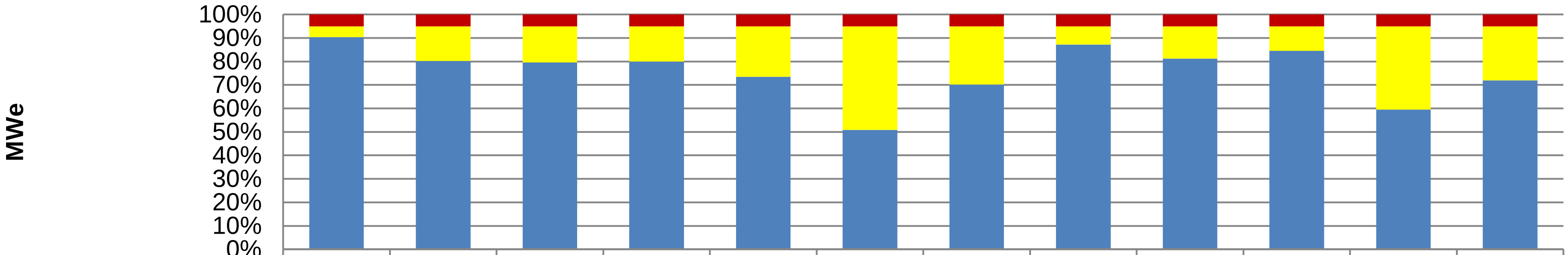
Three categories of flexibility allow a variety of resource types to help address flexible capacity need

Total Flexible Capacity MW Need by Category



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	414	463	418	360	306	376	318	305	344	448	480	497
Peak Flexibility	387	1,367	1,284	1,080	1,320	3,323	1,581	473	944	938	3,409	2,287
Base Flexibility	7,484	7,428	6,650	5,759	4,491	3,830	4,466	5,320	5,592	7,579	5,706	7,156

Percent of Total Flexible Capacity Need by Category



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Peak Flexibility	5%	15%	15%	15%	22%	44%	25%	8%	14%	10%	36%	23%
Base Flexibility	90%	80%	80%	80%	73%	51%	70%	87%	81%	85%	59%	72%

California ISO
Shaping a Renewed Future

Review of preliminary assessment results

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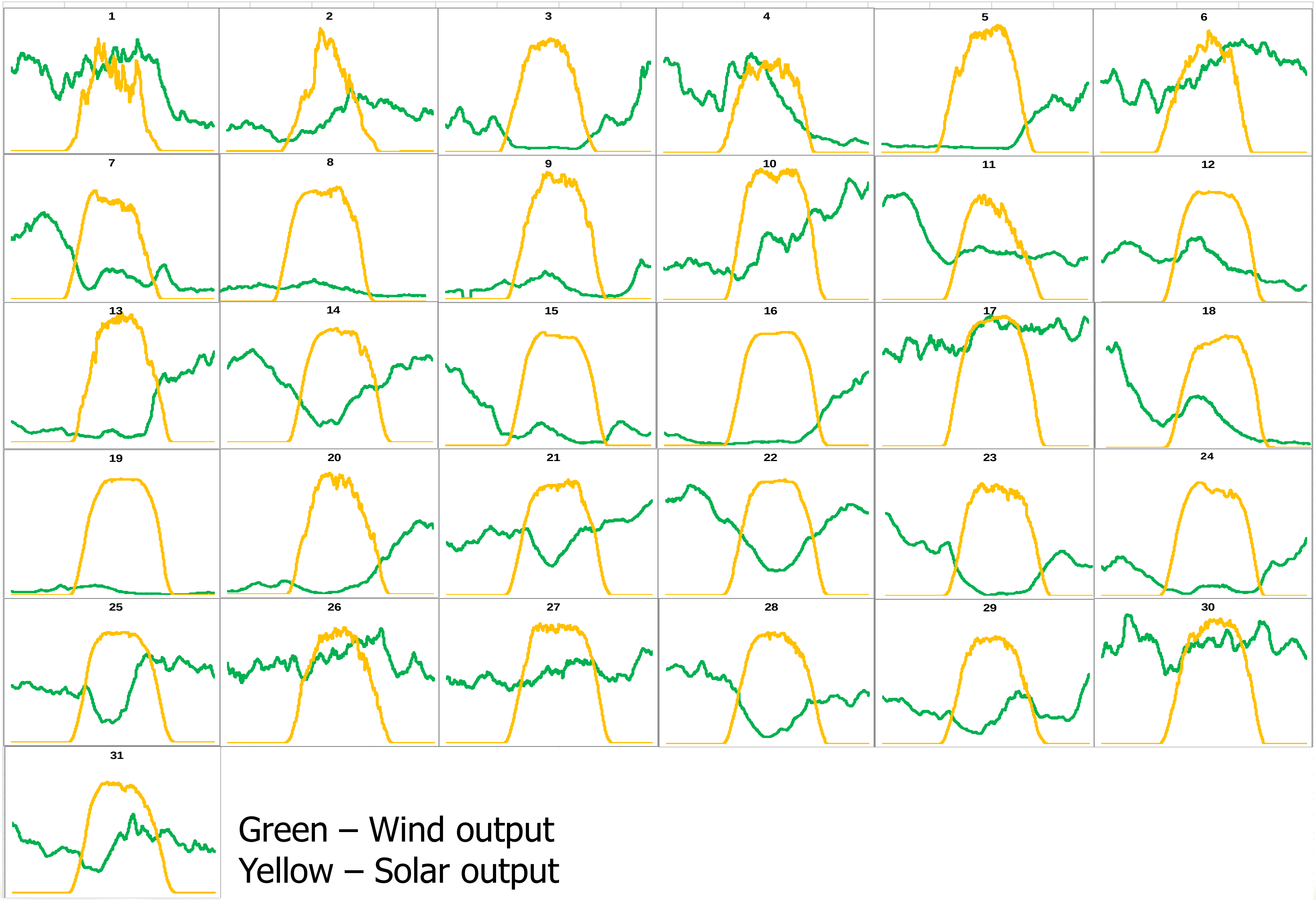
  - Flexible capacity makes up a greater percentage of resource adequacy needs during the off-peak months
  - Increase almost exclusively caused by 3-hour ramp, not increase in peak load
- Lower forecasts of variable energy resource build out contributes to lower flexible capacity requirements
- Compared to last year's forecast:
  - Flexible capacity needs are lower in many months,
  - Distribution of daily maximum three-hour net-load ramps are comparable
- Using the ISO flexible capacity contribution calculation majority of three-hour net-load ramps are attributable to CPUC jurisdictional LSEs
- Flexible capacity categories demonstrate that there is ample opportunity for participation from various resource types

Thank You!

Questions

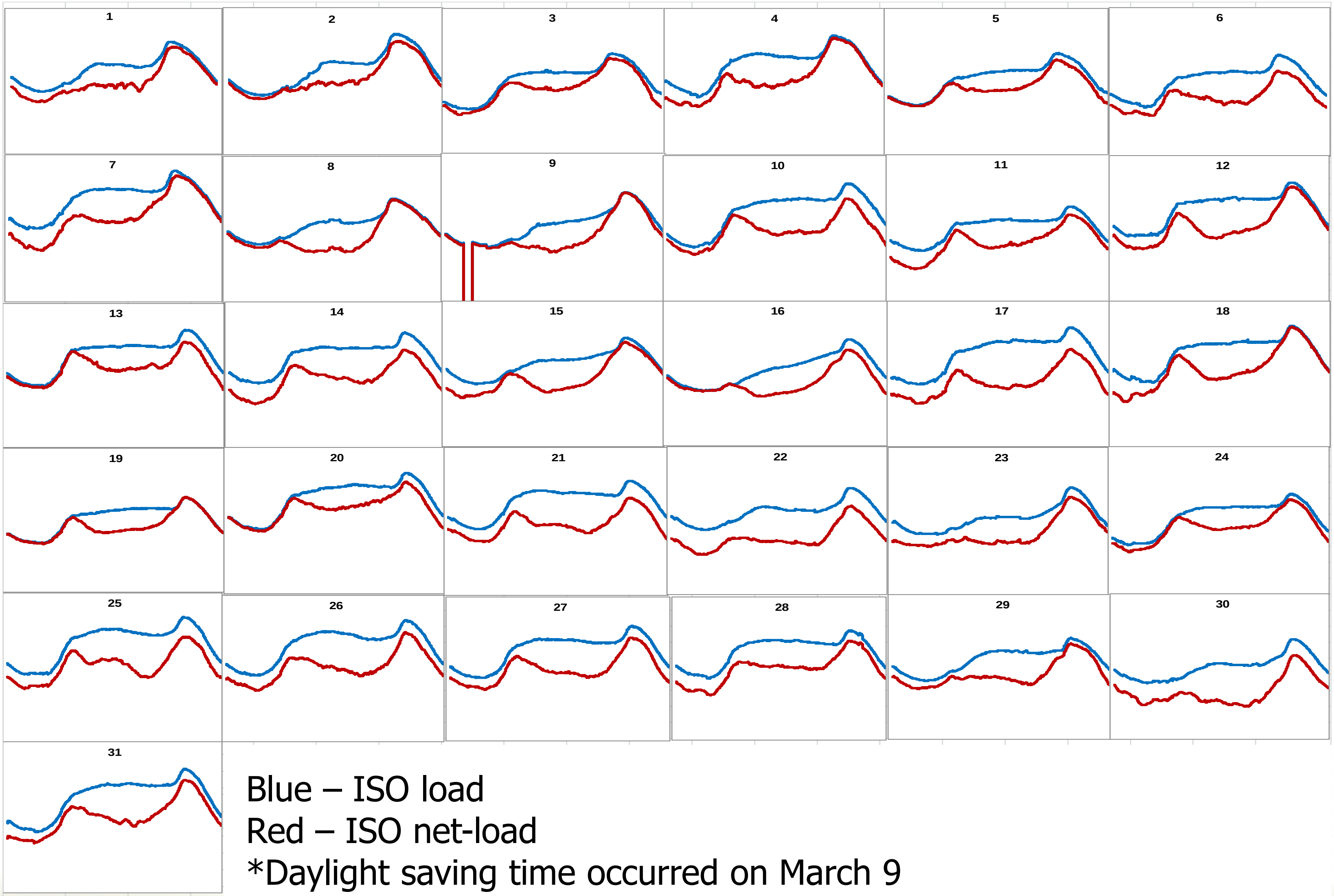
Appendix

Wind and solar production can change significantly from one day to the next --- March 2014



Green – Wind output
Yellow – Solar output

Load and net-load ramps can change significantly from one day to the next --- March 2014*



Blue – ISO load
Red – ISO net-load
*Daylight saving time occurred on March 9